NOISE LEVEL AT COAL BASED THERMAL POWER PLANT

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Abstract— Noise is defined as any unwanted sound that you do not need or want to hear. Loud noise can also create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals. There are number of locations in every old Thermal Power Plant who is responsible to create noise. Different Coal based Thermal Power Plants were selected from the decade 1980 to 2011. In thermal power plant, most of the section can create high decibel noise i.e. 90 dB to 95 dB and it is hazardous to human health. Sound becomes undesirable when it disturbs the normal activities such as working, sleeping, and during conversations it can also cause memory loss, severe depression, and panic attacks. ISO 1999 standard describes a model for the prediction of the distribution of the hearing loss at a given frequency, in a population of a given age, after a certain number of years of exposure to a LEX, 8h level. Use of a three Level risk scale provides guidance for the assessment of the Level of risk.

Level 1- Daily noise exposure level definitely below 80 dB (A), which has a minimal risk of noise induced hearing loss.

Level 2- Intermediate risk, lying between 80-85 dB (A) having some risk of noise induced hearing losses

Level 3- Daily noise exposure level definitely over 85 dB (A), the value for which it is recommended that Technical measures should be taken to reduce noise exposure.

The Risk evaluation due to Noise generation and the estimation of unaccepted level has been computed.

The potential hazard shall be controlled to eliminate the occupational health effects to the exposed persons either in acute or chronic sense.

Key word— **Noise, Hear, Thermal Power Plant, Level of Risk.**

I. INTRODUCTION

Noise related hearing loss has been listed as one of the most prevalent occupational health concerns around the globe for more than 25 years. Thousands of workers every year suffer from preventable hearing loss due to high workplace noise levels. Exposure to high levels of noise can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss. Short term exposure to loud noise can also cause a temporary change in hearing (your ears may feel stuffed up) or a ringing in your ears (tinnitus).These short term problems may go away within a few minutes or hours after leaving the noisy area. However, repeated exposures to loud noise can lead to permanent tinnitus and/or hearing loss.

Loud noise can also create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals. Noise induced hearing loss limits your ability to hear high frequency sounds, understand speech, and seriously impairs your ability to communicate. The effects of hearing loss can be profound, as hearing loss can interfere with your ability to enjoy socializing with friends, playing with your children or grandchildren, or participating in other social activities you enjoy, and can lead to psychological and social isolation.

- How does the ear work?
- What are the warning signs that your workplace may be too noisy?
- How loud is too loud?

How does the ear work?

When sound waves enter the outer ear, the vibrations impact the ear drum and are transmitted to the middle and inner ear. In the middle ear three small bones called the malleus (or hammer), the incus (or anvil), and the stapes (or stirrup) amplify and transmit the vibrations generated by the sound to the inner ear. The inner ear contains a snail like structure called the cochlea which is filled with fluid and lined with cells with very fine hairs. These microscopic hairs move with the vibrations and convert the sound waves into nerve impulses–the result is the sound we hear.

Exposure to loud noise can destroy these hair cells and cause hearing loss!

What are the warning signs that your workplace may be too noisy?

Noise may be a problem in your workplace if:

- You hear ringing or humming in your ears when you leave work
- You have to shout to be heard by a coworker an arm's length away
- You experience temporary hearing loss when leaving work

How loud is too loud?

Noise is measured in units of sound pressure levels called decibels, named after Alexander Graham Bell, using A-weighted sound levels (dBA). The A-weighted sound levels closely match the perception of loudness by the human ear. Decibels are measured on a logarithmic scale which means that a small change in the number of decibels results in a huge change in the amount of noise and the potential damage to a person's hearing.

OSHA sets legal limits on noise exposure in the workplace. These limits are based on a worker's time weighted average over an 8 hour a day. With noise, OSHA's permissible exposure limit (PEL) is 90 dBA for all workers for an 8 hour day. The OSHA standard uses a 5 dBA exchange rate. This means that when the noise level is increased by 5 dBA, the amount of time a person can be exposed to a certain noise level to receive the same dose is cut in half.

Typical levels of A-weighted sound levels against various scenarios

Sr. No.	Decibel dB(A)	Scenarios
1.	0	Threshold of hearing
2.	30	Soft whisper at 2m
3.	50	Urban residence
4.	60	Conversation at 1m
5.	70	Vacuum cleaner at 3m
6.	80	Heavy truck at 15m
7.	100	Jack Hammer at 3m
8.	110	Discotheque
9.	120	Jet take-off at 100m
10.	140	Threshold of pain

Table I. Typical A-weighted sound levels

In 1981, OSHA implemented new requirements to protect all workers in general industry (e.g. the manufacturing and the service sectors) for employers to implement a Hearing Conservation Program where workers are exposed to a time weighted average noise level of 85 dBA or higher over an 8 hour work shift. Hearing Conservation Programs require employers to measure noise levels, provide free annual hearing exams and free hearing protection, provide training, and conduct evaluations of the adequacy of the hearing protectors in use unless changes to tools, equipment and schedules are made so that they are less noisy and worker exposure to noise is less than 85 dBA.

II. METHODOLOGY AND LOCATION SELECTION FOR NOISE LEVEL SURVEY

All most all Thermal Power Stations (coal based) in India were established in the decade of 1980. Old technology as well as wear and tear in machine parts plays main role in noise creation. Over a period of time, frequent failures and leakages in different parts of machines and pipelines disturb the overall maintenance schedule of the plant. Some machine parts exceed the reliability period declared by manufacturers still did not replaced as they are in position to work. All these factors cumulatively result in hazard to human health. There are number of locations in every such old Thermal Power Plant who is responsible to create noise are listed below -

High Noisy Area Section

Turbine Floor
Turbine Basement
Boiler Feed Pump
Compressor Area
Firing Floor
Coal Feeder
Coal Mill
PA Fan
FD Fan
ID Fan
AHP Compressor Area
AHP Pump
GS Pump House
CW Pump House
Bunker House

Different Coal based Thermal Power Plants were selected from the decade 1980 to 2011, and are tabulated below in the table. units of 210 MW and one of 500 MW with different years of establishing were selected for noise level survey. The noise level survey was done at all the selected location in all the 05 plants for 12 months, monthly monitoring in all 22 sensitive locations in every Plant was done to get noise levels.

Stage	Unit No.	Installed Capacity (MW)	Date of Commissioning
1st	1	210	1989 March
1st	2	210	1990 January
1st	3	210	2000 April
1st	4	210	2001 January
1st	5	500	2011 August
Total	Five	1340	

The noise level survey for 12 months from April 2016 to March 2017. The annual average values of all the locations are tabulated and shown graphically in Results and Discussions

III. RISK EVALUATION AND ESTIMATION

The ISO 1999 standard describes a model for the prediction of the distribution of the hearing loss at a given frequency, in a population of a given age, after a certain number of years of exposure to a LEX, 8h level. From this standard, Figure below was derived; it gives, as a function of LEX, 8h, the percentage of the population aged 60 years, which, after 40 years of exposure, would develop mean hearing impairments (average 500 Hz, 1 kHz, 2 kHz, 3 kHz) greater than 25 dB. The figure shows that the risk of hearing impairment increases quadratically as a function of LEX, 8h. Therefore, if the risk is to be estimated with a given accuracy (for instance + 2%), the accuracy required for the evaluation of LEX, 8h increases: for instance, 88 + 2 dB (A) but 94 + 1 dB (A).

Use of a three level risk scale provides guidance for the assessment of the level of risk.

Level 1

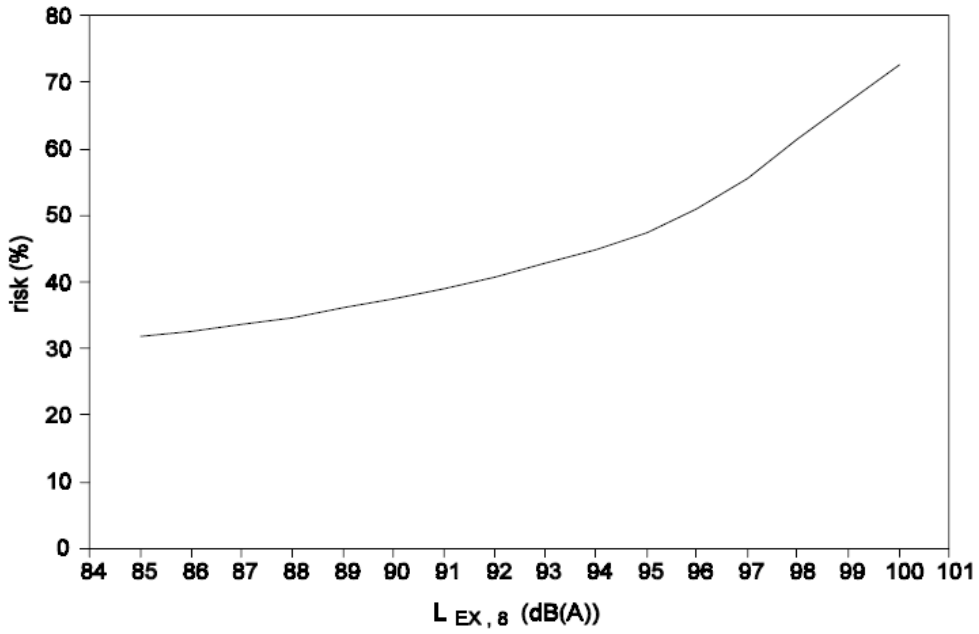
Daily noise exposure level definitely below 80 dB (A), which has a minimal risk of noise induced hearing loss

Level 2

Intermediate risk, lying between 80-85 dB (A) having some risk of noise induced hearing losses

Level 3

Daily noise exposure level definitely over 85 dB (A), the value for which it is recommended that Technical measures should be taken to reduce noise exposure.



Graph - Risk of hearing impairment as a function of the daily noise exposure level, LEX, 8h

As per the guidelines the permissible noise exposures is given in the table below as follows:

Sr. No	Duration (per Hour)	Sound Level (in dB(A))
1.	8	90
2.	6	92
3.	4	95
4.	3	97
5.	2	100
6.	1 ½	102
7.	1	105
8.	½	110
9.	¼	115

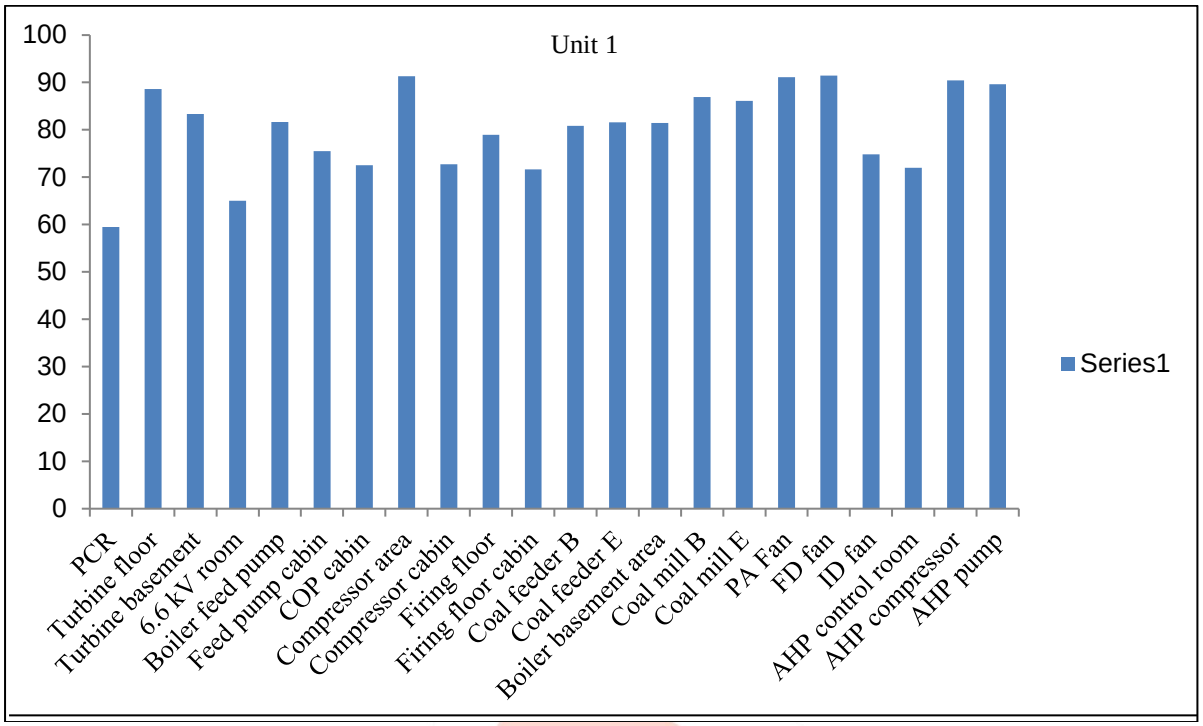
Table II. Permissible Noise as per OSHA guidelines

The average level of noise monitoring of all twelve months are represented in the following table and the most significant Noise level is categorized as Level 3.

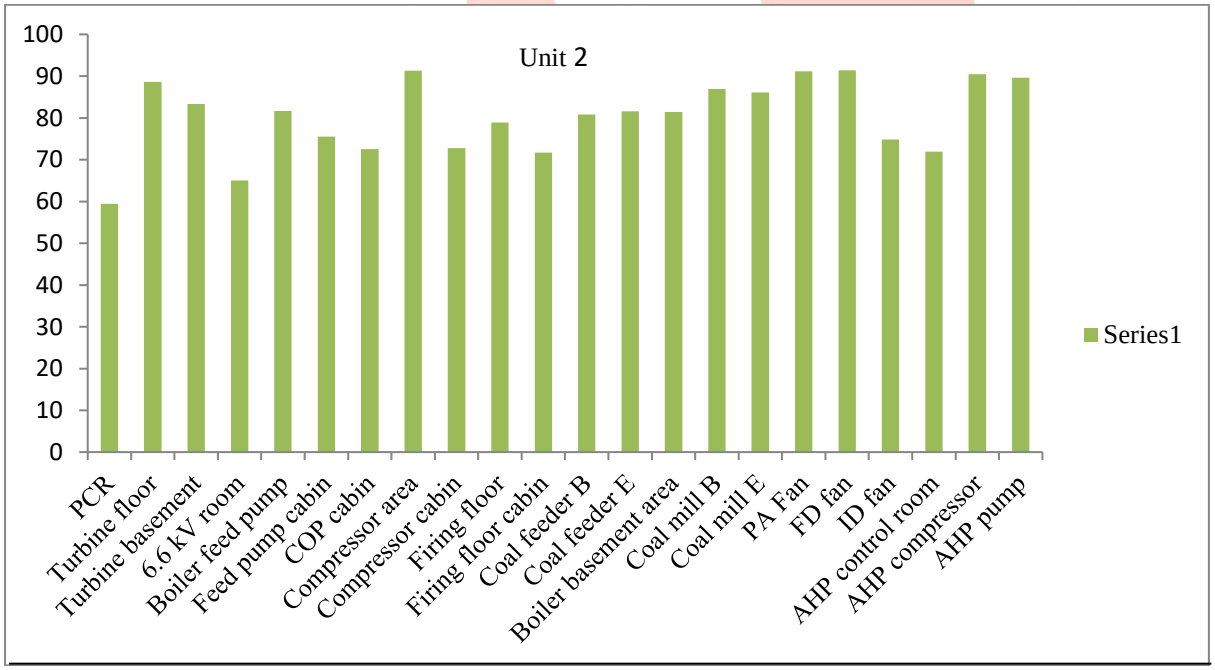
IV. RESULT AND DISCUSSIONS

Table I – Annual Average of Unit No.1, 2, 3, 4 & 5

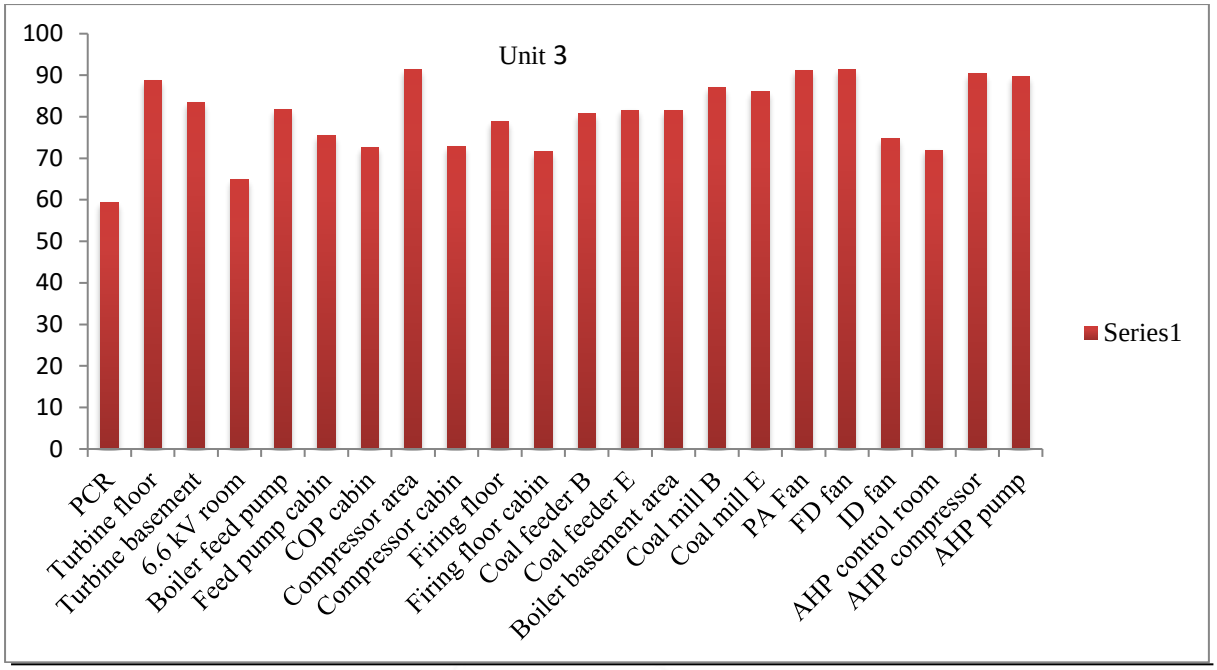
Sr. No.	Location	Unit No.1		Unit No.2		Unit No.3		Unit No.4		Unit No.5	
		LEX	*Level*	*LEX*	*Level*	*LEX*	*Level*	*LEX*	*Level*	*LEX*	*Level*
1.	PCR	58.3	1	57.67	1	58.88	1	59.68	1	59.45	1
2.	Turbine floor	85.00	3	85.08	3	84.00	2	84.00	2	88.63	3
3.	Turbine basement	81.60	2	80.92	2	82.76	2	78.74	1	83.32	2
4.	6.6 kV room	69.27	1	67.74	1	73.47	1	67.74	1	65	1
5.	Boiler feed pump	82.38	2	81.99	2	81.61	2	82.04	2	81.67	2
6.	Feed pump cabin	76.35	1	74.89	1	73.47	1	73.29	1	75.49	1
7.	COP cabin	71.14	1	75.13	1	74.07	2	74.68	1	72.51	1
8.	Compressor area	89.62	3	89.99	3	90.21	3	89.16	3	91.29	3
9.	Compressor cabin	61.14	1	76.04	1	79.5	1	75.85	1	72.75	1
10.	Firing floor	78.14	1	80.08	2	83.10	2	81.61	2	78.93	1
11.	Firing floor cabin	73.31	1	73.74	1	77.16	1	72.61	1	71.66	1
12.	Coal feeder B	86.33	3	85.72	3	84.92	2	81.67	2	80.82	2
13.	Coal feeder E	91.95	3	87.21	3	83.63	2	82.08	2	81.6	2
14.	Boiler basement area	83.44	2	84.5	2	85.57	3	84.54	2	81.45	2
15.	Coal mill B	83.6	2	83.11	2	83.71	2	79.92	1	86.93	3
16.	Coal mill E	85.13	3	83.4	2	83.9	2	82.7	2	86.11	3
17.	PA Fan	84.48	2	86.26	3	88.25	3	86.62	3	91.12	3
18.	FD fan	86.05	3	85.93	3	87.90	3	86.14	3	91.42	3
19.	ID fan	82.69	2	83.85	2	78.05	1	77.07	1	74.8	1
20.	AHP control room	64.99	1	66.1	1	63.9	1	62.53	1	71.96	1
21.	AHP compressor	83.82	2	88.25	3	82.36	2	78.31	1	90.45	3
22.	AHP pump	84.05	2	76.8	1	81.8	2	81.31	2	89.65	3



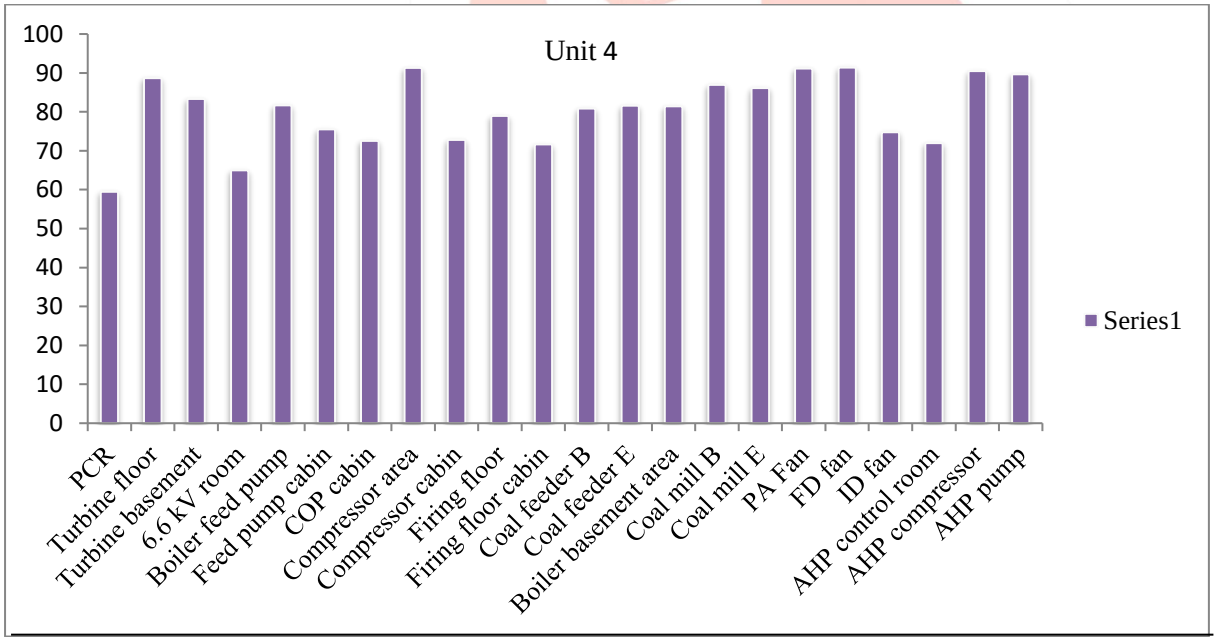
Graph 1 Annual Average Noise Level at Unit No. 1



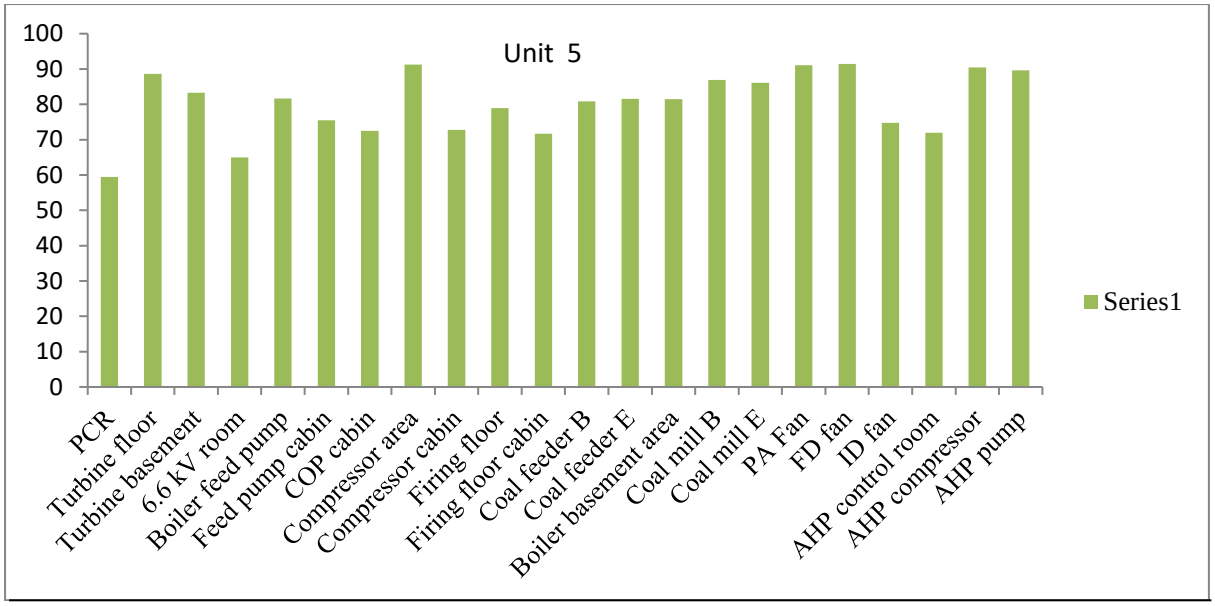
Graph 2 Annual Average Noise Level at Unit No. 2



Graph 3 Annual Average Noise Level at Unit No. 3

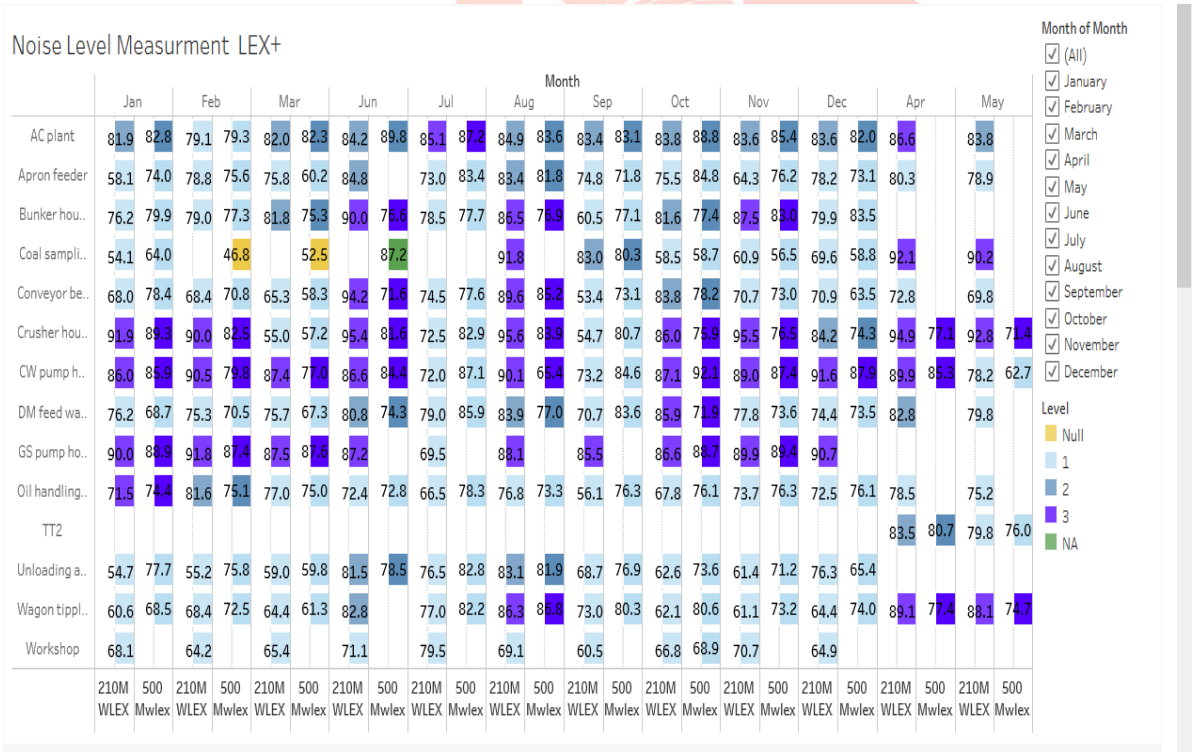


Graph 4 Annual Average Noise Level at Unit No. 4



Graph 5 Annual Average Noise Level at Unit No. 5

The annual average noise level cumulative values are represented and studies statistically using software "Table" for Units 1,2,3,4 & 5.



Graph 6 Annual Average of Unit No. 1,2,3,4 & 5

V. RISK REDUCTION & CONCLUSIONS

As with any occupational hazard, control technology should aim at reducing noise to acceptable levels by action on the work environment. Such action involves the implementation of any measure that will reduce noise being generated, and/or will reduce the noise transmission through the air or through the structure of the workplace. Such measures include modifications of the machinery, the workplace operations, and the layout of the workroom. In fact, the best approach for noise hazard control in the work environment is to eliminate or reduce the hazard at its source of generation, either by direct action on the source or by its confinement.

Practical considerations must not be overlooked; it is often unfeasible to implement a global control program all at once. The most urgent problems have to be solved first; priorities have to be set up. In certain cases, the solution may be found in a combination of measures which by themselves would not be enough; for example, to achieve part of the required reduction through environmental measures and to complement them with personal measures (e.g. wearing hearing protection for only 2-3 hours), bearing in mind that it is extremely difficult to make sure that hearing protection is properly fitted and properly worn.

For Thermal power plants, the major noise sources are coal unloading plant, coal crusher plant, compressor, boiler feed pump, turbine, Forced Draft Fan (F.D. fan), Induced Draft Fan (I.D. fan), Demineralized plant (D.M. plant), cooling tower, aerial rope way etc.

Noise control measures are required to be implemented according to the hierarchy of control so far as reasonably practicable.

The Risk evaluation due to Noise generation and the estimation of unaccepted level has been computed and tabulated in Table and graphical representation is done in Graph.

The common Noise generating sources in the Coal Based Thermal Power Plant on the basis of monthly noise level monitoring from April 2016 to March 2017, it is concluded that the following are the most Noise Generating Areas.

- Turbine
- Generators
- Fan Intake & Exhaust (PA, ID, FD fans)
- Motors
- Steam Exhaust
- Centrifugal blowers
- Compressors
- Piping and ducts

This potential hazard shall be controlled to eliminate the occupational health effects to the exposed persons either in acute or chronic sense. There are different tools and methods available globally which may be suggested as mitigation measures to reduce the risk to the acceptable level.

Replacement of old machines with modern noise reducing or noiseless machines is highly recommended. Acoustician and using PPEs is the instant solution for getting respite from the situation.

Green Walls by developing Green Belt in the area shall help in reducing ambient noise level in the area.

VI. INFERENCE

It is concluded that the overall maintenance of the plant and following of the individual maintenance schedule of the equipment is very much helpful in achieving noise level reductions.
The Organization may consider the maintenance schedule with less intervals to get more reduction in noise level.
Strict implementation of Engineering and Administrative Controls, Compulsion of using PPEs and Personal Hearing Protectors shall be done.
'**High Noise Level Zone**' Warning Display shall be done at all the areas where LEX Noise Level is 3 and use of Personal Hearing Protectors shall be made mandatory before entering such zones.
Audiometric Medical Check Up for the persons working in **High Noise Level Zone** shall be mandatory and special precautions shall be taken to reduce their exposure.
Hazard of noise may be put in safety awareness programs.

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